SPECTRAL STUDIES ON SOME OF THE PLANETARY NEBULÆ.

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THE spectrometer which I have described appeared to me at first incapable of giving good results upon the nebulæ, but it is not generally true. If they are of great extent, as those in Orion, &c., then the image cannot be linear, and the distinct monocromatic spectral lines are wanting. But with the planetary nebulæ it is different. Considering the apparent disc of some of these, I expected that even in the spectrometer the monocromatic zone would have a diameter equal to it; but that was not so. The planetary nebulæ, instead, give the very fine lines indicated for the first by Mr. Huggins; and as the new spectrometer enfeebles their light much less, it renders them more easy to examine. Up to the present time I have studied four of these nebulæ—the annular in Lyra; that in Sagittarius, in R.A. 19h. 34m., decl. −14°·32′, which has a diameter 25″·8; that of Struve, R.A. 18h. 4m., decl. 6°·50′, diam. 7″·6; that of Andromeda, R.A., 23h. 18m., decl. +41°·36′; greatest diam. 22″·5.

The three latter are figured in our "Memoirs" of 1856, and have a considerable diameter. These nebulæ give, in the spectrometer, the principal monocromatic line very sharp and very fine, accompanied by some other also very fine lines.

In the annular nebula in Lyra that line appears double, but there may be doubts if the duplicity belongs to the two arches of the nebula; that of Sagittarius is single, and has another very fine line as near as the other is broad, at the side of the violet; and, at intervals, a very faint distant line is visible.

That of Struve has a much brighter spectrum, and the three lines are quite distinct.

That of Andromeda has the lines above named, but the principal one is a little diffused, and all the field is slightly illuminated, and certainly it cannot be said that all trace of stellar spectrum is wanting. Thence it is important in this family of objects. Our figure drawn in 1856 shows some stellar points in it.

As it is a little paradoxical that the image of an object having a sensible diameter should be reduced to a line, it will not be amiss to explain how this happens. If, from a refractor directed towards the full moon, the eyepiece is taken away, and an achromatic lens of short focus is placed at a short distance from the principal focus, it will be seen that the image diminishes, though not much; but it will be observed that *beyond* the image the rays are concentrated in a very small space without forming there an image properly so called. Now, the same happens with the cylindrical lens; this, in one direction only, and in a place beyond the true image, produces a linear concentration of rays which occupies the place of the slit. The breadth of the image is not properly zero, but is so much diminished that its breadth appears to be insensible. That explains why I did not at first see these lines distinct, as I looked at the focal position of the stars, whilst it was requisite to look further off for the objects having a diameter. Thus also the planets, up to a certain point, give a linear image; but it is impossible to reduce their image to a convenient narrowness if the diameter exceeds some seconds, and thence it cannot be made available for all objects. But for facilitating the study of these mysterious celestial bodies, such as the planetary nebulæ, it is an advantage to be able to do it with an instrument as economical and simple as our spectroscope is.